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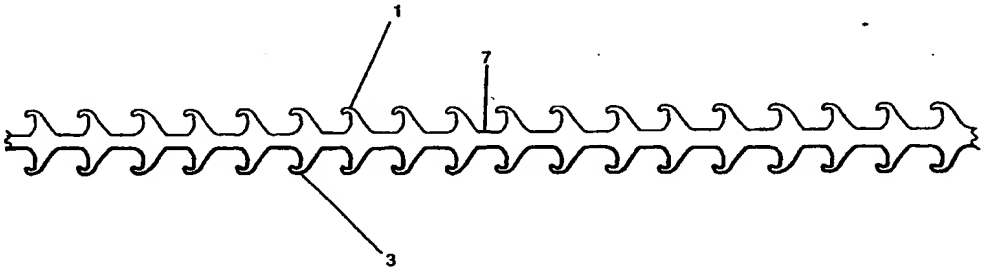

(57) Abstract

A back-to-back hook fastener having hook-shaped fastening elements (1) extending from one side of a base member (7) and anchoring elements (3) extending from an opposite side of the base member(7), the fastening elements (1) and anchoring elements (3) being individually molded integrally with the base member (7). The back-to-back fastener is useful for integrally molding fastening elements (1) into a molded article for subsequent attachment of another part having mating loop elements. Alternatively, the back-to-back fastener is useful, when the anchoring elements (3) are hook-shaped, for joining together loop components of hook and loop fasteners. The back-to-back hook fastener is made by extruding a web of molten thermoplastic resin into the nip formed between two molding rolls (14, 15), the molding rolls (14, 15) having cavities around their peripheries in which the fastening elements (11) and anchoring elements (3) are molded.

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BACK-TO-BACK HOOK FASTENER

Background of the Invention

The invention relates to hook components that are used as part of a hook and loop fastening system. In particular, the invention relates to hook components that can be used in insert molding processes, or as a coupler between two loop components.

In insert molding, a fastener component, typically a hook component, is integrally molded into a part such that the fastening elements of the component are exposed above the surface of the part. Another part carrying the mating fastener component, e.g. the loop component, can then be attached to the molded article by attaching the loops to the upstanding fastening elements. To facilitate anchoring of the hook component into the molded article, it desirable to provide anchoring elements on the side of the component that is molded into the molded article.

One approach to providing such an anchoring element is to glue a strip of anchoring elements, which could be either hooks or loops, to the back side of the hook component. This approach has certain disadvantages. First, the gluing process is a separate, post-production process that adds to production cost. Second, with certain materials the adhesive bond is not strong enough to provide firm hook attachment, even when good anchoring into the plastic article is achieved. In such a situation, the hook component can delaminate from the strip of anchoring elements. This is especially true where both the hook component and the strip of anchoring elements are plastic parts, a solvent based adhesive is used, and there is insufficient "breathability" of the parts for adequate drying and cure of the adhesive.

Another approach is to laminate loop fabric directly to a molded hook component, which tends to give a good bond and works satisfactorily in many processes. However, in many other processes (especially injection molding, in which there are high temperatures and pressures and in which the plastics involved do not bond very well), hook-like anchoring elements have proven to be more effective than loop elements.

Other prior art fastener products having a back-to-back hook configuration include woven hook components having fastening elements on both sides of the component. Woven hooks, however, tend to have cross sections on the order of 0.008 to 0.010 inches, which makes them susceptible to damage during insert molding processes. Other back-to-back products include fasteners formed by means of a cut-and-stretch technique in which a continuous sheet having hook-profiled ribs is extruded, the ribs are sliced in the cross-sheet direction, and the tape is stretched to separate individual hook and anchor elements.

Summary of the Invention

In general, the invention features a back-to-back fastener product having fastening elements on one side of a base member and fastening elements or other anchoring elements on the other side of the base member that are integrally molded with the base member. The spacing (both along the length of the fastener and across its width), orientation, and geometries of the fastening elements and anchoring elements are set by the molding process and can all be varied. The spacing, orientation, and geometries of the fastening elements are set independently of the spacing, orientation, and geometries of the anchoring elements.

In preferred embodiments, the back-to-back fastener product is formed by a continuous forming method

in which molten material is extruded into the nip formed between two molding rolls. One of the molding rolls has cavities along its surface that mold the fastening elements; the other has cavities along its periphery that mold the anchoring elements.

By molding the fastening elements and anchoring elements of the back-to-back fastener, and doing so independently, a high degree of design flexibility is realized. For example, reinforcing ribs or rip-stops (essentially, raised bumps on the base member that reinforce both the fastening elements and the base, thereby increasing its tear strength) can be incorporated into the fastener.

Furthermore, preferred embodiments have fastening elements facing in alternating directions, which gives good shear strength along either lengthwise direction of the fastener. The fastening elements can be spaced in a checkerboard pattern or even in a random fashion if so desired. Such spacing tends to increase the flexibility of the fastener, because when the fastening elements are arranged in a line across the width of the tape, they tend to function as rib-like structures that increase the stiffness of the fastener.

Flexibility of the fastener is also enhanced due to the fact that, in contrast to a product in which a sheet of anchoring elements is glued to the base of a hook component, there is just a single, common base member. This single base member is thinner, and hence more flexible, than the combined base layer of a glued back-to-back product. Furthermore, the glue necessary to assemble a glued product, which increases stiffness of the product, is avoided. Thus, the invention provides increased flexibility of the fastener, which enhances the ability of the fastener to conform to the product into which it is to be molded.

The fastening elements are designed to have fastening properties that allow mating loop elem nts to be repeatedly attached and detached from the fastening elements, as is typical of hook and loop fasteners. The anchoring elements, on the other hand, are designed to have sufficient strength to embed the fastener firmly into a molded product. Molding allows these goals to be realized with a high degree of certainty as to how the hook or anchoring elements will perform. Although both fastening elements and anchoring elements should have continuously tapering cross sections, which allows for easy removal from the molding rolls, the anchoring elements need not be in the shape of simple hooks. They can, for instance, be Y-shaped, double-hooked, or of similar shape which increases their resistance to being pulled from the object into which the fastener is molded. However, even where both fastening elements and anchoring elements are hook-shaped, satisfactory anchoring is obtained as 100% of the anchoring elements are embedded, whereas typically only about 30% to 40% of fastening elements engage loop elements.

In a further embodiment, elements designed as hooks are provided on both sides of the base member, in contrast to embodiments wherein elements on one side are designed as anchoring elements. Such a fastener can be used as an "adaptor" between loop fastener components. For example, it is common in the automotive industry to bond a loop fastener to the floor of a car and weave a loop backing into the car carpet itself. A fastener according to the invention having back-to-back hooks can be used to attach the carpeting to the floor of the car.

A molded back-to-back fastener has the advantages of being manufactured in a single process, which saves production costs. Furthermore, the problem of the two halves of the fastener delaminating, as occurs with a

product in which the two halves are glued to each other, is avoided.

In another general aspect, a back-to-back fastener is produced using a continuous forming method wherein molten material is extruded into the nip formed between a pair of nip rolls that have cavities around their peripheries. By maintaining the temperature of the extruded material and the surfaces of the nip rolls at relatively precise temperatures, it is possible to force molten material into the cavities to form fastening elements and anchoring elements. When they are pulled from the cavities, the hooks and anchoring elements straighten but then spring back to and retain their molded shape.

The resins should be extracted from the cavities at temperatures in the range of approximately 150° F to 200° F, which is substantially below their melting points, but above the temperatures at which resins would be extracted from molds in a typical injection molding process. For example, whereas nylon would be extracted from an injection mold at approximately 150° F, it is pulled from the mold cavities of the nip rolls at approximately 175° F.

The anchoring elements are stripped from their forming cavities soon after exiting the nip. The fastening elements are allowed to remain in their forming cavities for approximately half a revolution of the nip roll in which they are molded. This allows for more perfect formation of the fastening elements than the anchoring element, because the fastening elements are given more time to cool. Of the two types of elements, perfectly formed hooks are more desirable than perfectly formed anchoring elements because fewer hooks, percentagewise, are engaged by fastener loops.

Additional processing can include in-lin application of a protective encasement to the fastening elements. The encasement protects the fastening elements from contamination and deformation when the fastener product is molded into a part, such as by injection molding or compression molding processes.

Numerous other features, objects, and advantages of the invention will become apparent from the following detailed description when read in connection with the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a side view of a roll of molded back-to-back fastener with its fastening elements encased and its anchoring elements exposed.

Fig. 1A is a close-up view in cross section of the circled region of Fig. 1.

Fig. 1B is a close-up side view of a molded back-to-back fastener showing a single fastening element and a single anchoring element.

Fig. 1C is a side view of a continuous tape of a molded back-to-back fastener.

Fig. 1D is a side view of a continuous tape of a molded back-to-back fastener having palm-tree-shaped anchoring elements.

Fig. 1E is a side view of a continuous tape of a molded back-to-back fastener having Y-shaped anchoring elements.

Fig. 2 is a side elevational view of apparatus used to manufacture a molded back-to-back fastener.

Fig. 3 is a side view showing a molded back-to-back fastener as it is molded by nip rolls.

Fig. 4 is a close-up showing a molded back-to-back fastener being formed in the nip between the nip rolls of Fig. 3.

Fig. 5 is a perspective view of a back-to-back fastener showing the fastening elements arranged in evenly spaced rows and columns.

Fig. 6 is a perspective view of a back-to-back fastener showing the fastening elements arranged in varying directions.

Fig. 7 is a perspective view of a back-to-back fastener showing the fastening elements arranged in checkerboard fashion.

Fig. 8 is a perspective view of a back-to-back fastener showing rip-stops between fastening elements.

Figs. 9-12 are side views, partially in cross, showing a back-to-back fastener being integrally molded with a molded article, and the product produced thereby.

Figs. 13 and 14 are side views, partially in cross section, showing upholstery being attached to an automotive seat cushion.

Detailed Description

As shown in Figs. 1 and 1A, a back-to-back mold-in hook component includes molded plastic anchoring elements 3 and molded plastic fastening elements 1 partially encased by protective encasement 5. Anchoring elements 3 anchor the hook component into a molded article, such as a plastic article formed by injection or compression molding. After the molded article is formed, protective encasement 5 is stripped away from fastening elements 1.

As shown in Fig. 1A, an enlarged view of the circled portion of Fig. 1, encasement 5 covers most of the fastening elements 1, but the tops are left slightly exposed. As shown in Fig. 1B, yet a further enlargement showing a single fastening element 1 and a single anchoring element 3, both fastening element 1 and anchoring element 3 are formed integrally with base 7 and have cross sectional areas which diminish from base 7 to the top of the hook 9 or to the top of the anchoring

element 11. Fastening element 1 has a height, h, ranging from about 0.020 to 0.125 inches, which is typical f molded fastening elements as known in the hook and loop fastener industry. Anchoring element 3 has a height, h', ranging from about 0.025 to 0.125 inches. Base 7 has a thickness, t, which ranges from about 0.008 to 0.030 inches.

The geometry of anchoring element 3, which is not limited to the traditional hook shape as commonly found in hook and loop fasteners, will vary depending on the product into which the hook component is molded. Although shown herein as a simple wave-shaped hook, anchoring element 3 could be formed as a double hook, a palm tree shape as shown in Fig. 1D, a Y shape as shown in Fig. 1E, or any other geometry suitable for anchoring the hook fastener component into a molded article.

In Fig. 1C, the hook component of Fig. 1 is shown with encasement 5 removed. As shown, fastening elements 1 and anchoring elements 3 are identical and have the same pitch (elements per inch). Such a configuration, however, is not necessary. Because all anchoring elements 3 will be embedded in the molded article, there can be fewer anchoring elements per inch of fastener component than fastening elements 1, only a portion of which actually engage with loop elements of a mating loop fastener component. Furthermore, although shown as facing the same direction, fastening elements 1 and anchoring elements 3 can face in opposing directions, or in various combinations of directions.

A preferred method of making a back-to-back hook component, having fastening elements 1 and anchoring elements 3, is similar to the continuous forming method taught in Fischer, U.S. Patent No. 4,794,028, the entire disclosure of which is hereby incorporated herein by reference. As shown in Fig. 2, apparatus for fabricating

a back-to-back fastener includes extruder 10, traditional sheeting dye 12, frame 18 to support a series of rolls, molding roll 14, additional molding roll 15, take-away nip rolls 24, and winder 28 with separate spindles 30 for collecting the finished product.

Fig. 3 is a closeup of molding rolls 14 and 15 and chilling roll 17, which are mounted on frame 18 as shown in Fig. 2. A molten web of resin E is extruded from sheeting dye 12 of extruder 10. A small puddle or "reservoir" P is allowed to form just in front of the nip formed between molding rolls 14 and 15, which helps ensure complete filling of the cavities in the molding rolls. The back-to-back molded product F is stripped from the lower molding roll 15, but is allowed to adhere to molding roll 14 approximately half way around its periphery. Molded product F is then stripped from molding roll 14 and passes over the top of smooth chilling roll 17.

Rolls 14, 15, and 17 are supported by rotary unions 34, which allow internal cooling of the rolls. Molding rolls 14, 15 are composed of molding rings which are mounted on shell 32, as disclosed in Fischer, U.S. Patent No 4,794,028 (incorporated by reference supra). Water circulates through internal water passageway 33, located within shell 32, thereby cooling the molding rings and hence, molding rolls 14, 15.

Because virtually all of anchoring elements 3 are embedded in the part into which the back-to-back hook component is to be molded, whereas only a portion of fastening elements 1 actually engage loop elements, it is preferable to have perfectly formed fastening elements 1 as opposed to perfectly formed anchoring elements 3. Therefore, because the molded product F maintains contact with molding roll 14 for a longer period of time than it does with molding roll 15, providing for better control

of the quality of the elements formed by molding roll 14, molding roll 14 should be used to mold the fastening elements 1, and molding roll 15 should be used to mold the anchoring elements 3.

As shown in Fig. 4, molten web E is extruded from sheeting dye 12 into the nip formed between molding rolls 14 and 15. Upper molding roll 14 has molding cavities 50, spaced about its periphery, in which fastening elements 1 are formed. Similarly, lower molding roll 15 has molding cavities 51, spaced about its periphery, in which anchoring elements 3 are formed. Molding rolls 14 and 15 are pressed towards each other with approximately 2,000 to 3,000 pounds of force per linear inch of width. Thus, if molding rolls 14 and 15 are fifteen inches wide, 30,000 to 45,000 pounds of force is applied. Such force is necessary to force the molten material E, which is quite viscous, into molding cavities 50, 51.

Back-to-back molded product F can be manufactured from a variety of materials. Plastics that can be used include nylons, polyethylene, polypropylene, vinyls, and polyesters, all of which are extruded by extruder 10 and through sheeting dye 12 in a molten state. The temperature of the molten web E and the surface temperature of the molding rolls 14, 15 are maintained such that the molten resin flows into cavities 50, 51 to form fastening elements 1 and anchoring elements 3. For example, polyolefins should be extruded at a temperature of from 400°F to 450°F, and the surface of molding rolls 14, 15 should be maintained at 150°F to 160°F. Nylon 12 should be extruded at a temperature of from 475°F to 500°F, and the surface of molding rolls 14, 15 should be maintained at 180°F to 190°F. Nylon 6,6 should be extruded at a temperature of from 575°F to 600°F, and the surface of molding rolls 14, 15 should be maintained at 180°F to 190°F.

As indicated in Figs. 2 and 3, anchoring elements 3 are stripped from their molding cavities 51 at a first stripping station at the exit side of the nip formed between molding rolls 14, 15, but fastening elements 1 remain embedded in their molding cavities 50 for approximately half a revolution of molding roll 14. Fastening elements 1 are stripped from their molding cavities 50 at a second stripping station approximately at the top of molding roll 14, due to tension applied to the molded product F by take-away nip rolls 24, by passing the molded product F over chilling roll 17.

Because molding roll 14 is cooled by water circulating through it, the fastening elements 1 are cooled such that they do not deform unacceptably when they are pulled from their molding cavities 50. Additionally, cooling of the molding roll 14 enhances cooling of the exposed anchoring elements 3 such that, by allowing the anchoring elements to cool for a sufficient period of time, they are not permanently and detrimentally crushed as the molded product F passes over chilling roll 17. Cooling of molded product F continues as it passes over chilling roll 17, and further cooling occurs as it continues downline towards spindles 30.

Although not shown in Fig. 2, two sets of take-away nip rolls 24 can be used in series. Two sets, however, are not necessary, and various other apparatus can be provided for secondary product processing. For example, additional cooling means can be added to the production line. Alternatively, processing means can be set up between frame 18 and nip rolls 24 to apply a protective encasement 5 (Figs. 1, 1A) to the fastening elements 1. A second extruder can be positioned downline from chilling roll 17 which extrudes flexible PVC (polyvinyl chloride), or some other encasement material, onto the molded product F, and heating elements could be

provided to activate a blowing agent added to the flexible PVC to cause the flexible PVC to foam. Encasement 5 is then nipped onto the fastening elements 1. Alternatively, encasement 5 can be calender coated or cast onto fastening elements 1 with appropriate tooling at similar locations. The manufacture and application of encasement 5 to fastening elements 1 is described in greater detail in the U.S. patent application entitled "Die Cut Mold-In", filed July 6, 1993 by Donald L. Banfield et al. (incorporated by reference supra).

The back-to-back hook fastener thus produced can be anchored firmly into a molded article, leaving the fastening elements exposed (once the protective encasement is removed) for attachment to the loop component of a hook and loop fastener. Because the anchoring elements and fastening elements are integrally molded, delamination of the anchoring elements from the fastening elements is avoided. Furthermore, because the back-to-back hook fastener is molded in a single process step, manufacturing costs are reduced. Finally, individually molding the fastening elements and anchoring elements, in a method similar to the continuous forming method as disclosed in Fischer, U.S. Patent No 4,794,028 (incorporated by reference supra), permits a high degree of versatility in terms of fastener design. The fastening elements 1 can be arranged in evenly spaced rows and columns, as shown in Fig. 5; they can be oriented in varying directions, as shown in Fig. 6; and they can be spaced in checkerboard fashion, as shown in Fig. 7. Furthermore, reinforcing rip-stops 13 can be molded integrally with fastening elements 1 and base member 7, as shown in Fig. 8.

As shown in Figs. 9 - 14, in use, a back-to-back hook fastener -- preferably with the fastening elements 1 partially encased in a protective elastomeric encasement

5, as shown in Fig. 1A -- is secured in trough 102 of mold 100 with the anchoring elements 3 exposed to the cavity 104 of the mold. Mold 100 is used to make, for example, foam automobile seat cushions or other injection molded items. Chemicals 110 are introduced into the mold cavity (Fig. 10) and combine to form the foam material of the seat cushion, flowing around and encapsulating the fastening elements such that they become embedded in the molded article 112 (Fig. 11). The molded article 112 is removed from the mold 100 and the protective elastomeric encasement 5 is removed from the fastening elements 1, thereby exposing them above the surface of the molded article.

Other items can then be attached to the molded article 112. For example, fabric upholstery 114 is attached to the molded article -- an automobile seat cushion in this case -- by engaging the fabric of the upholstery with the fastening elements 1 (Fig. 13). Alternatively, the upholstery can be attached to the molded article by engagement of a loop fastener component 116, attached to the upholstery, with the fastening elements 1.

It should be noted that the back-to-back fastener component can be integrally molded with articles made by other molding processes as well, such as compression molding and liquid plastic molding. Furthermore, although the anchoring elements 3 are shown in Figs. 9 and 10 as hook-shaped, other geometries for the anchoring elements are possible, as described above.

What is claimed is:

1. A method for making a fastener component having a base member, first molded protrusions extending from a first surface of said base member, and second molded protrusions comprising fastening elements extending from a second, oppositely directed surface of said base member, said fastening elements capable of engaging loops of a mating loop fastener component, said method comprising:

extruding molten thermoplastic resin;

causing said resin to enter a nip formed between a first molding roll and a second molding roll; said first and second molding rolls each having a distribution of molding cavities around its respective periphery for molding, respectively, said first molded protrusions and said second, fastening element molded protrusions;

causing said resin to flow into the cavities in said first and second molding rolls to form said first molded protrusions and said second, fastening element molded protrusions, the resin emerging from said nip formed as said fastener component;

stripping said fastener component from one of said molding rolls at a first stripping station as soon as, or shortly after, said resin emerges from said nip while allowing the fastener component to remain on the other of said molding rolls; and

subsequently stripping said fastener component from the other of said molding rolls at a second stripping station.

2. The method of claim 1 wherein the molding roll on which said fastener component remains following stripping at said first stripping station is cooled and said second stripping station is spaced by a substantial arc from said nip such that said fastener component is cooled by said cooled molding roll, said cooling

preventing permanent deformation of the molded protrusions which are removed from the caviti s of said cooled molding roll at said second stripping station.

3. The method of claim 2 wherein said arc is in excess of about 90°.

4. The method of any of the foregoing claims wherein said fastener component is stripped at said second stripping station by passing said fastener component around a third roll disposed near said second molding roll.

5. The method of claim 4 wherein the molding roll on which said fastener component remains following stripping at said first stripping station is cooled, and the fastener component remains on said cooled roll for a sufficient duration such that the molded protrusions which are stripped at said first stripping station are sufficiently cooled such that contact with said third roll does not cause detrimental distortion of the molded protrusions which contact said third roll.

6. The method of any of the foregoing claims wherein said resin is extruded directly into said nip.

7. The method of any of the foregoing claims wherein an amount of extruded resin forms a bank of excess resin in the region directly preceding said nip.

8. The method of any of the foregoing claims wherein said first molded protrusions are stripped from said one of said forming rolls at said first stripping station and said second, engaging element molded

protrusions are stripped from said other of said forming rolls at said second stripping station.

9. The method of any of the foregoing claims wherein said first and second molding rolls have respective configurations such that said fastener component has less of said first molded protrusions, per unit of length in the lengthwise direction thereof, than said second, fastening element molded protrusions.

10. The method of any of the foregoing claims wherein said first molded protrusions are configured and arranged to serve as anchoring elements when embedded in a molded article.

11. The method of any of the foregoing claims wherein said first molded protrusions have a shape comprising a trunk extending from said base member and at least two arms branching from said trunk.

12. The method of claim 11 wherein said first molded protrusions are Y-shaped.

13. The method of claim 11 wherein said first molded protrusions are palm tree-shaped.

14. A product formed by the method of any of the foregoing claims.

15. A method of making a molded article having a fastener component incorporated therewith, said fastener component having a base member, a multiplicity of fastening elements extending from a first surface of said base member, and a multiplicity of anchoring elements

extending from a second, opposite surface of said base member, said method comprising:

extruding molten thermoplastic resin;

causing said resin to pass through a nip formed between a first molding roll and a second molding roll; said first and second molding rolls having cavities around their respective peripheries for molding said anchoring elements and said fastening elements integrally with said base member;

causing said resin to flow into the cavities in said first and second molding rolls to form said anchoring elements and said fastening elements, the resin emerging from said nip formed as said fastener component;

stripping said fastener component from said first and second molding rolls;

placing said fastener component in a mold for making said molded article with said anchoring elements exposed to the cavity of said mold;

introducing material from which said molded article is to be made into said mold cavity such that said material flows around and encapsulates said anchoring elements, said anchoring elements thereby becoming anchored in said molded article, and

removing said molded article from said mold, thereby exposing said fastening elements.

16. The method of claim 15 wherein said fastener component is formed by the method of any of claims 1-13.

17. A molded article formed by the method of claim 15 or 16.

18. A molded article comprising

a seat cushion having a fastener component integrally molded therein, said fastener component

comprising a base member, a multiplicity of fastening elements integrally molded with and extending from a first surface of said base member, and a multiplicity of anchoring elements integrally molded with and extending from a second, oppositely directed surface, said anchoring elements being embedded in said seat cushion and said fastening elements extending above a surface of said seat cushion, and

a sheet of fabric upholstery attached to said seat cushion by engagement of the fabric of said upholstery with said fastening elements.

19. A molded article comprising

a seat cushion having a hook fastener component integrally molded therein, said hook fastener component comprising a base member, a multiplicity of hook fastening elements integrally molded with and extending from a first surface of said base member, and a multiplicity of anchoring elements integrally molded with and extending from a second, oppositely directed surface, said anchoring elements being firmly embedded in said seat cushion and said hook fastening elements extending above a surface of said seat cushion, and

a sheet of fabric upholstery having a loop fastener component attached thereto, said sheet of fabric upholstery attached to said seat cushion by engagement of said loop fastener component with the hook fastening elements of said hook fastener component.

20. A molded article comprising

a molded seat cushion, and

a hook fastener component integrally molded with said molded seat cushion,

said hook fastener component comprising

a base member,

a multiplicity of individually and discret ly molded, generally hook-shaped fastening elements extending from a first surface of said base member and integrally molded with said base member, and

a multiplicity of individually and discretely molded anchoring elements extending from a second, oppositely directed surface of said base member and integrally molded with said base member.

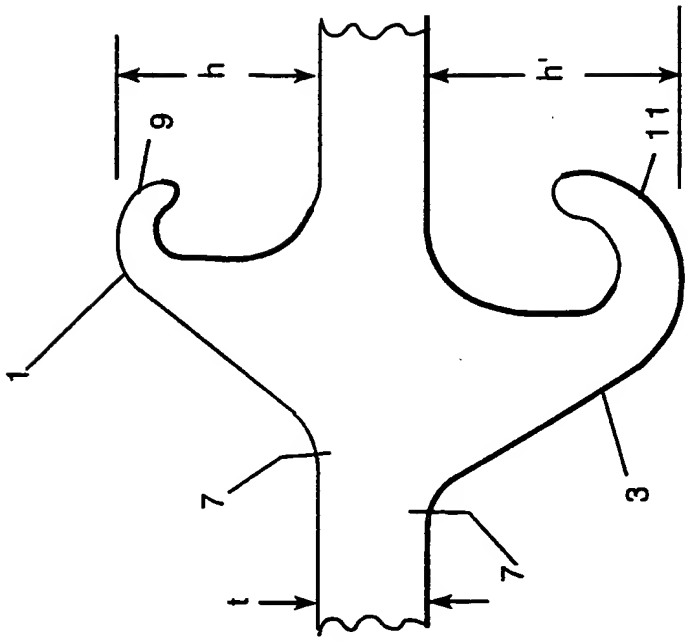

FIG. 1B

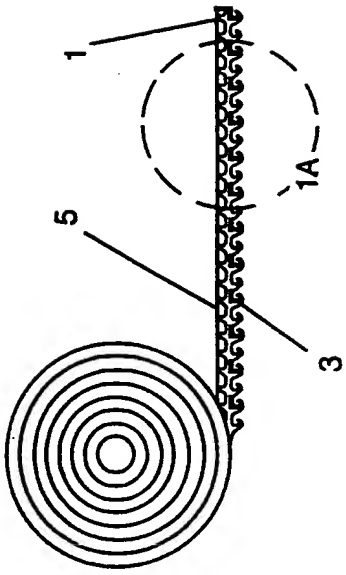

FIG. 1

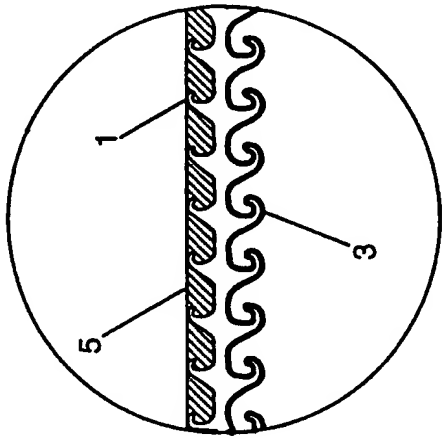

FIG. 1A

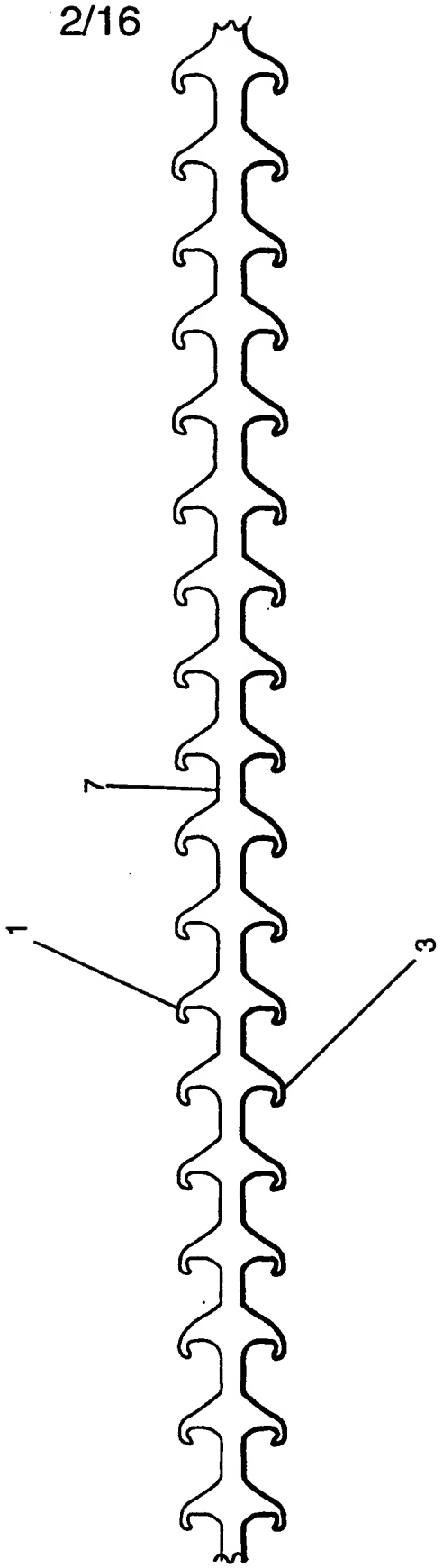

FIG. 1C

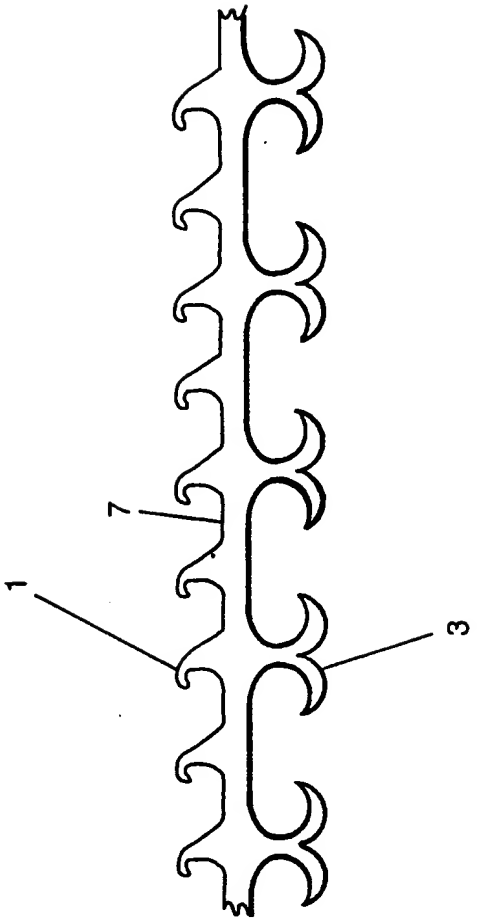

FIG. 1D

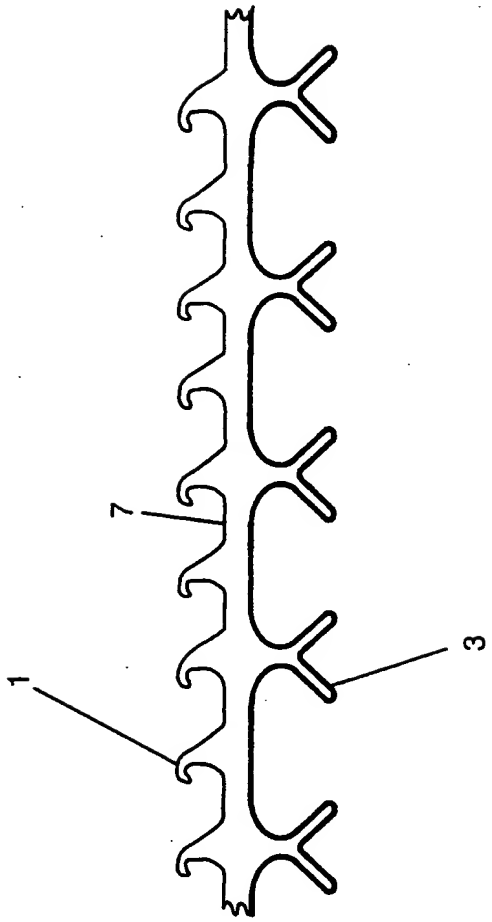

FIG. 1E

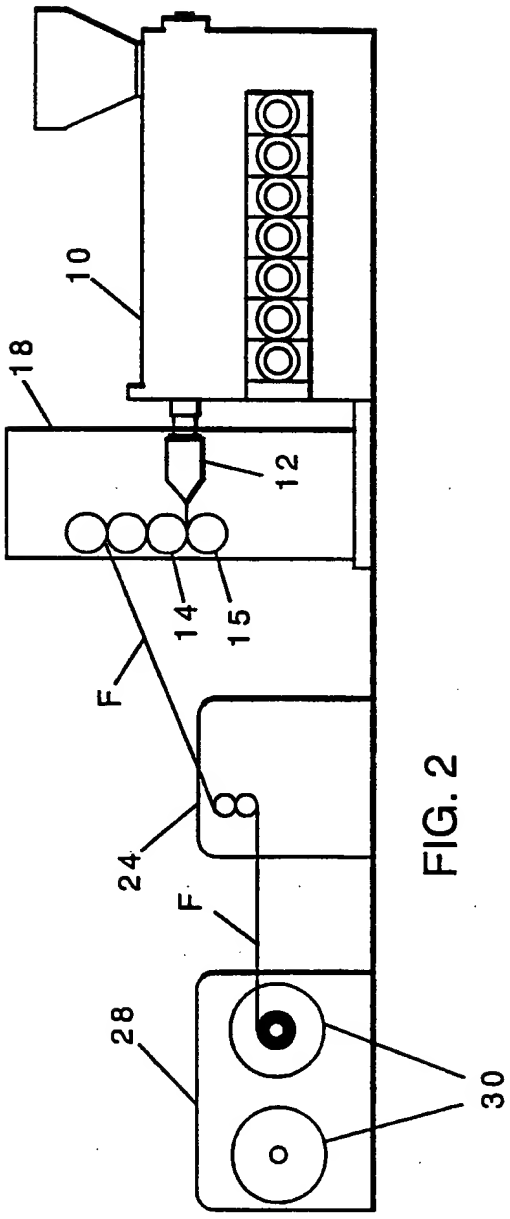

FIG. 2

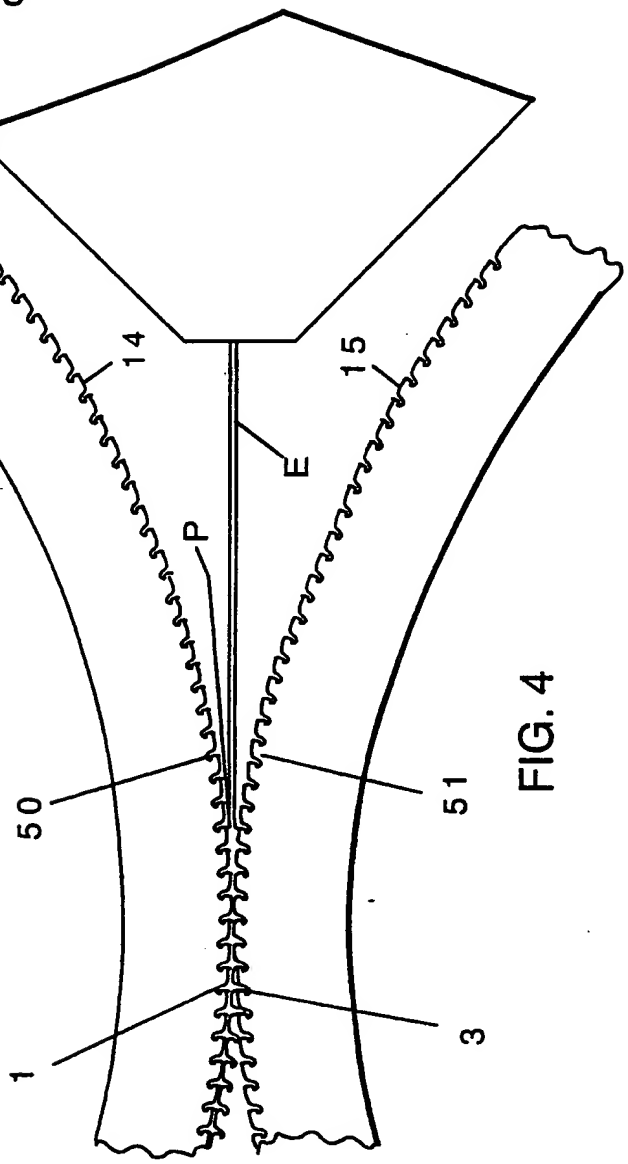

FIG. 4

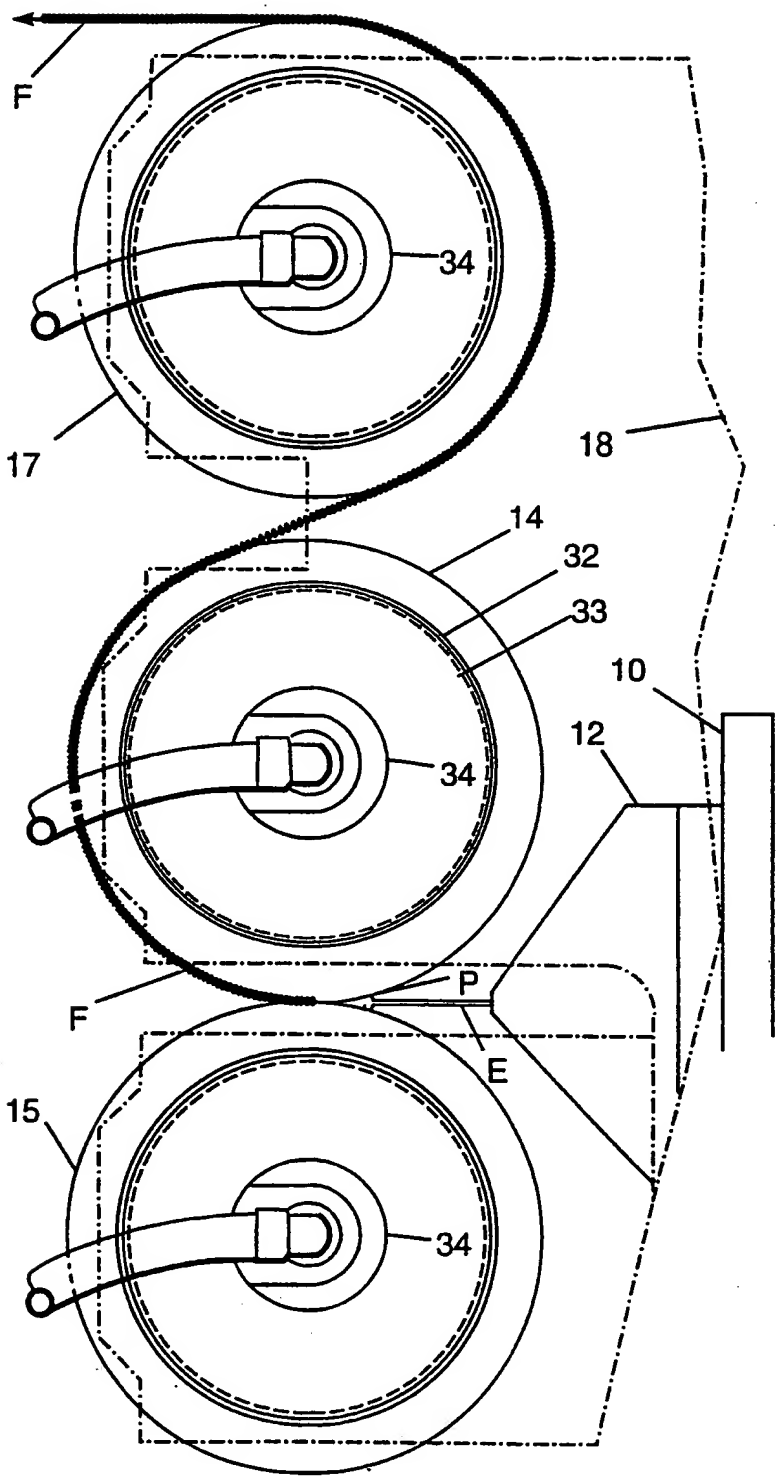

FIG. 3

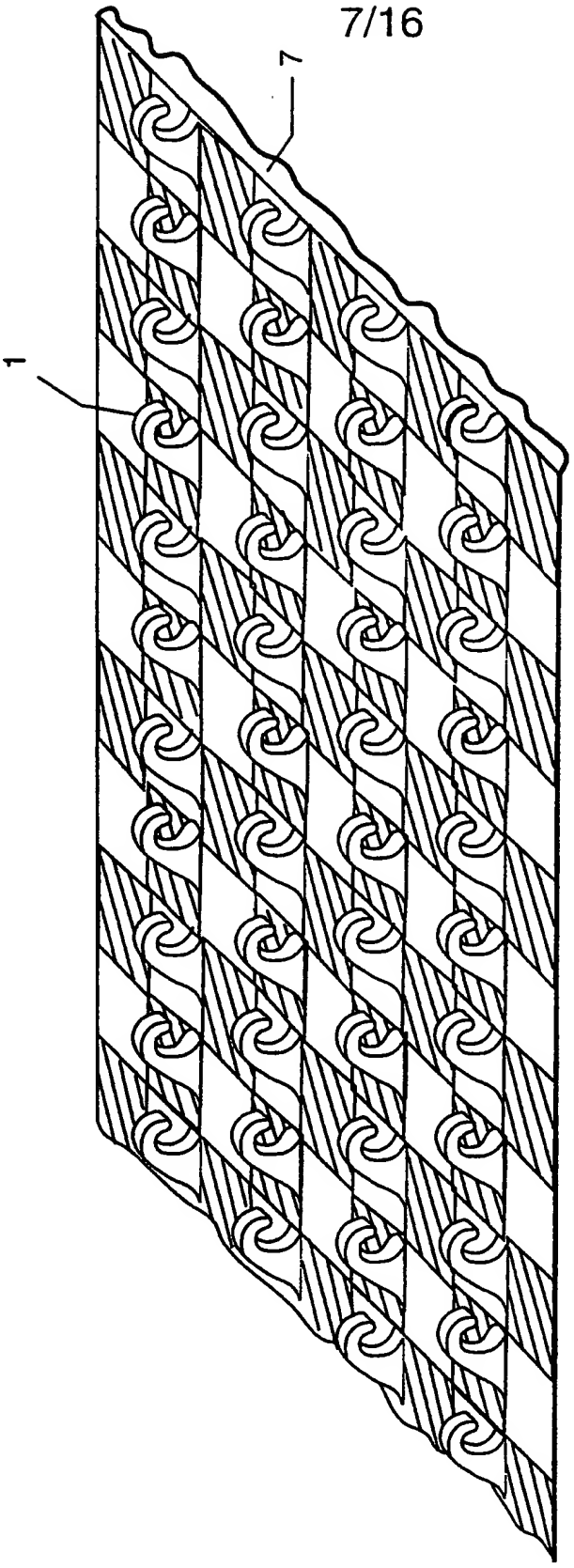

FIG. 5

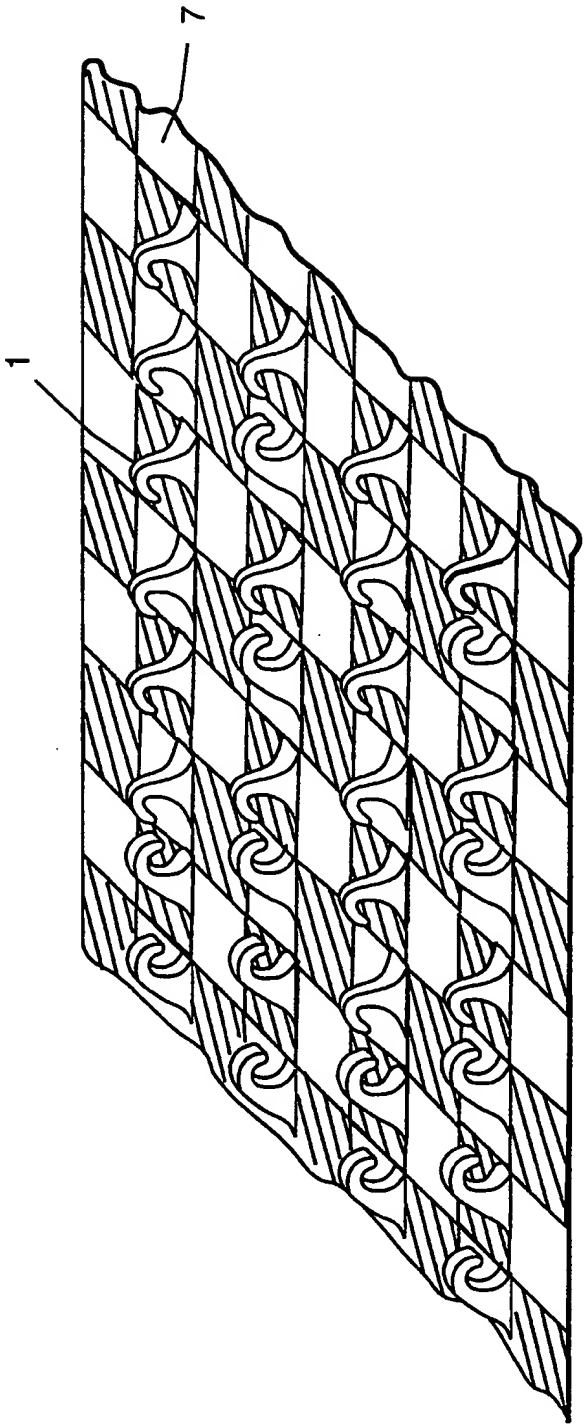

FIG. 6

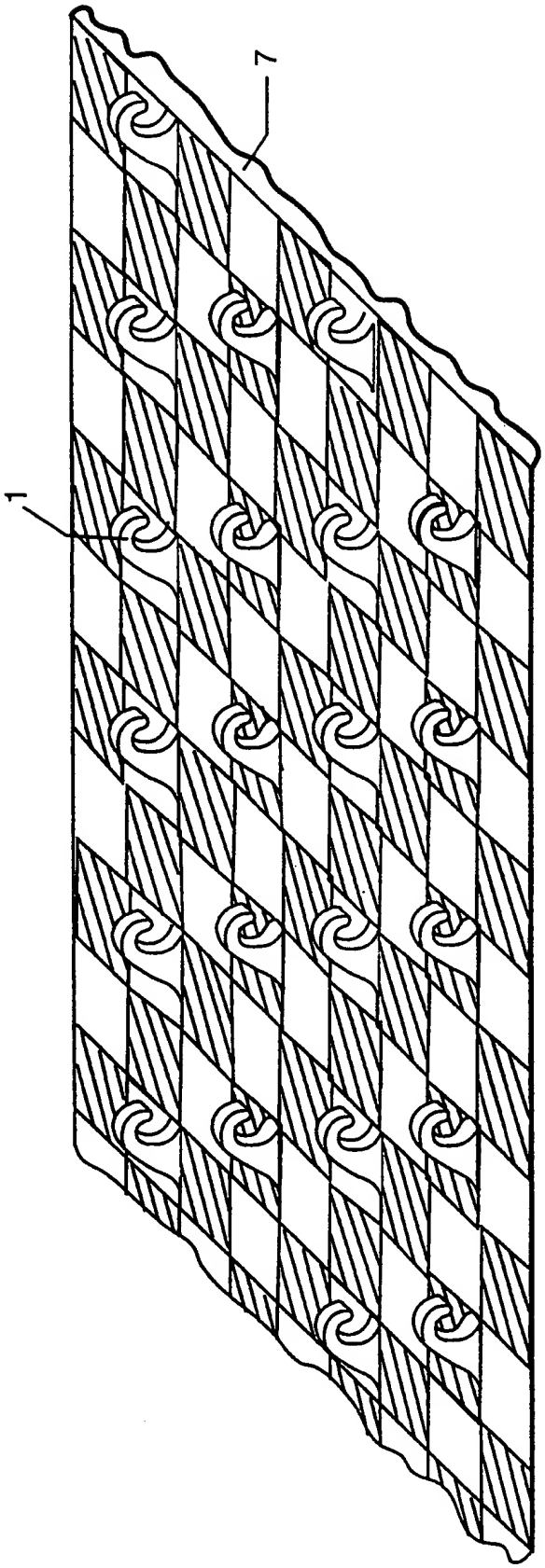

FIG. 7

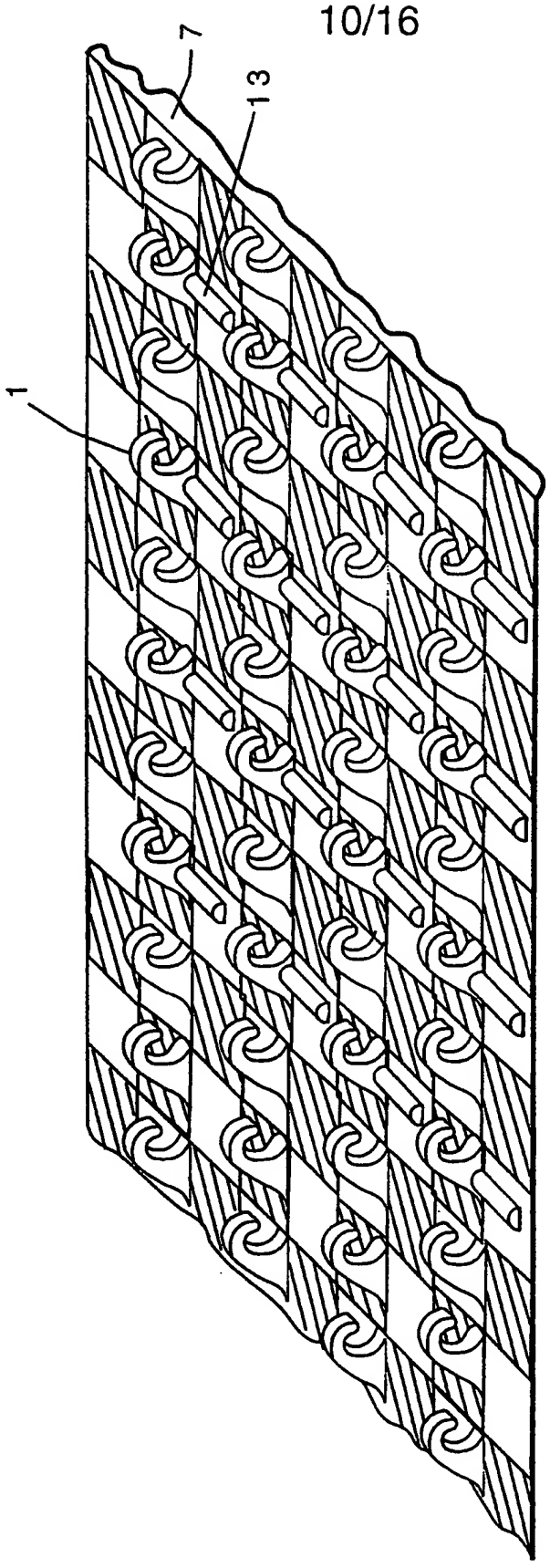

FIG. 8

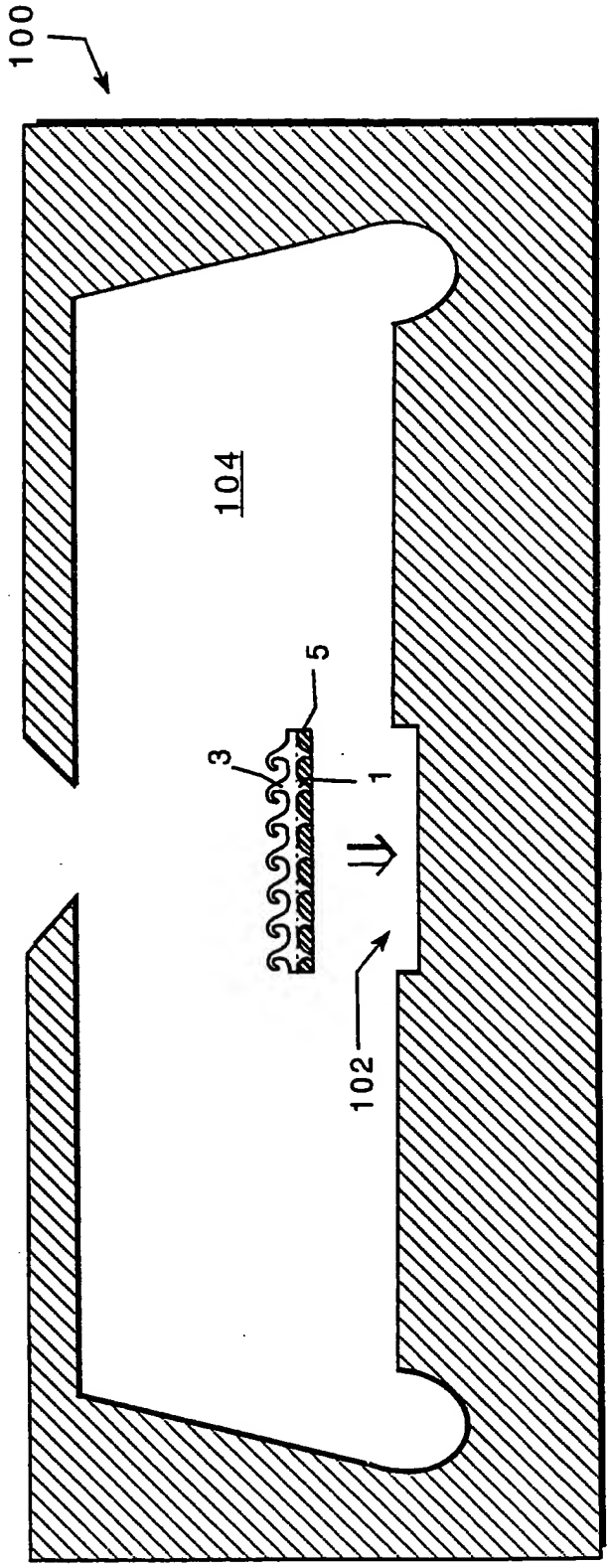

FIG. 9

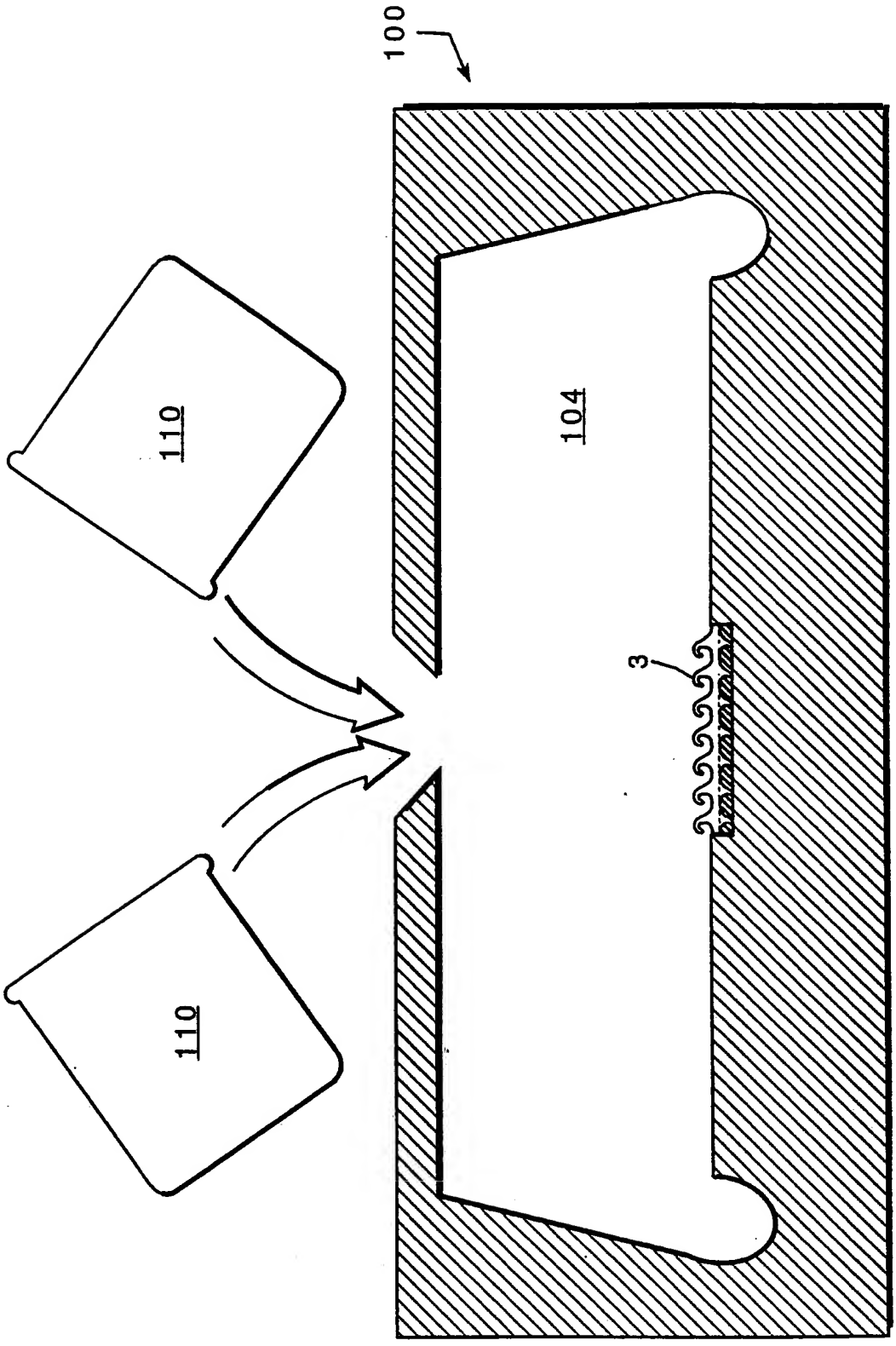

FIG. 10

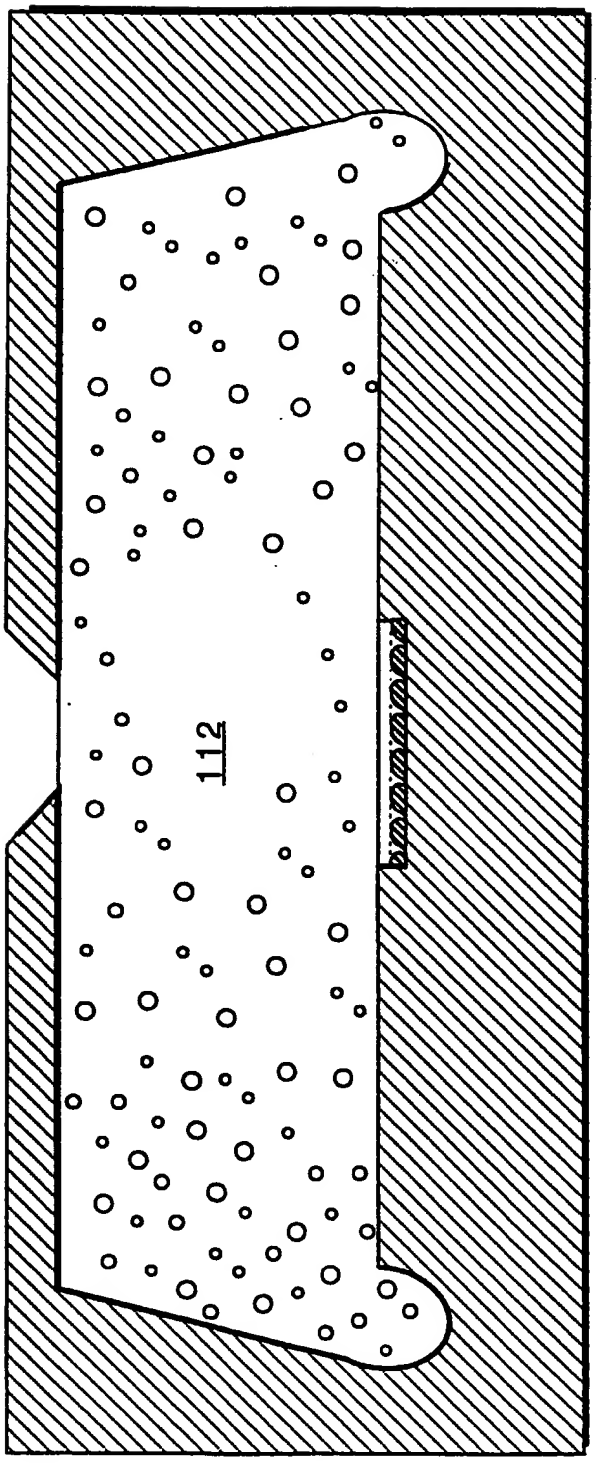

FIG. 11

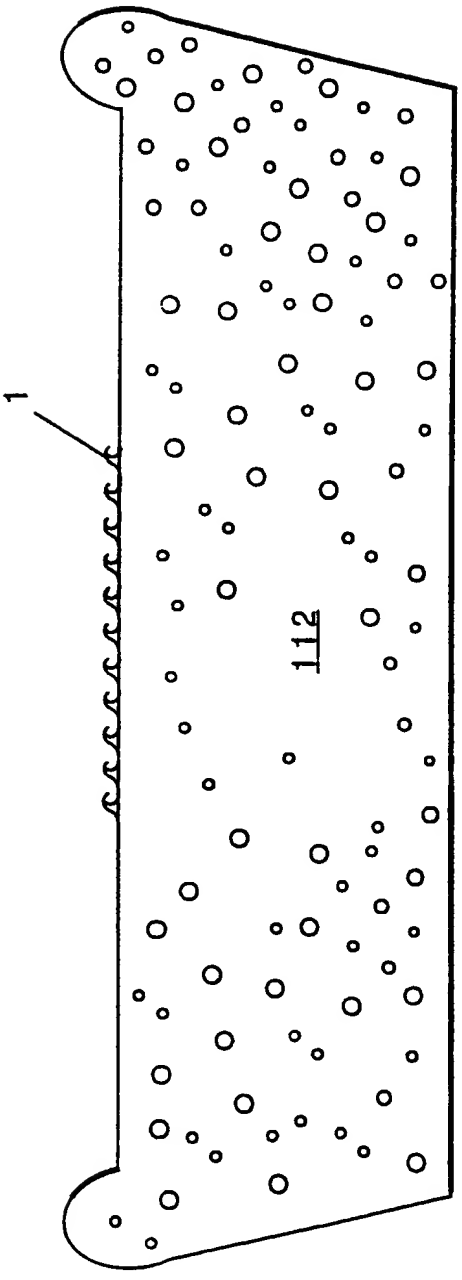

FIG. 12

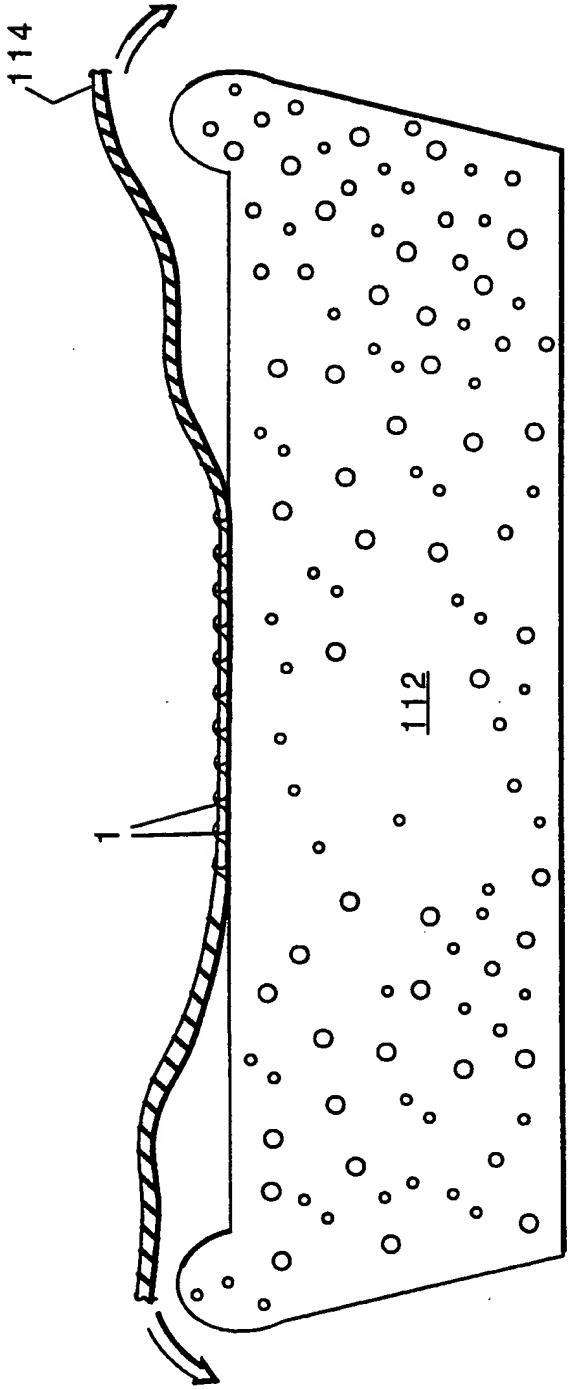

FIG. 13

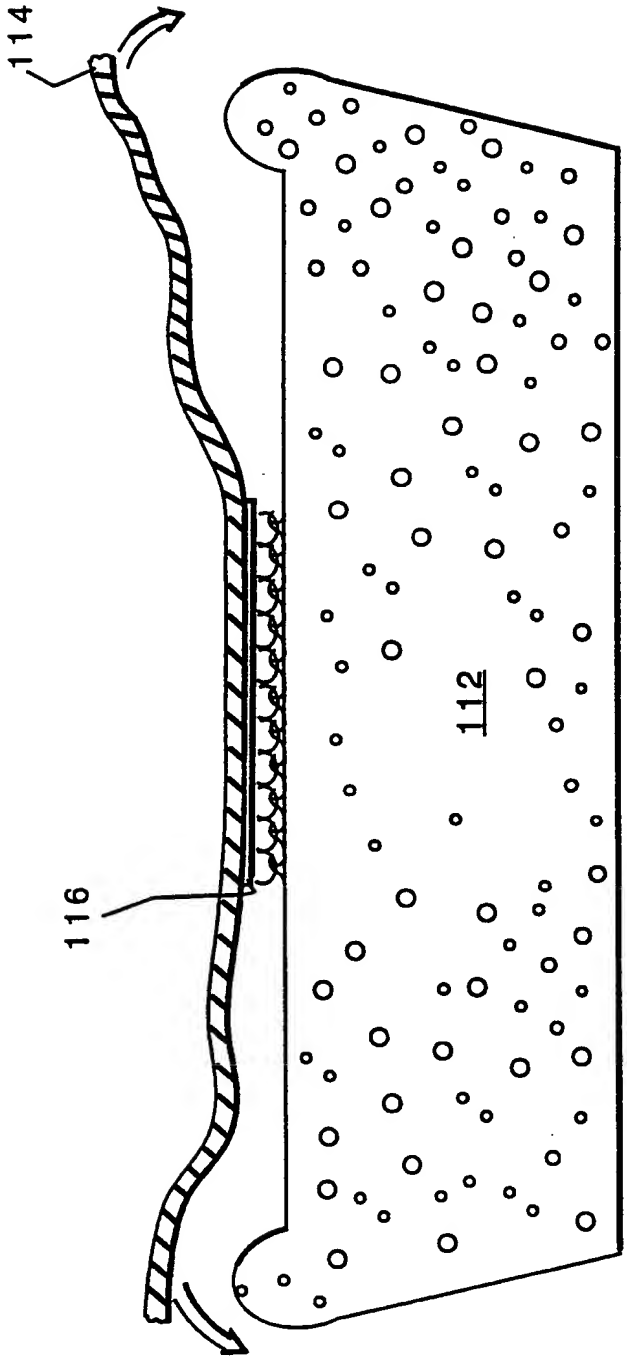

FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/07556

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B29C 43/46; A44B 18/00; B32B 3/30

US CL :Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 428/100, 120; 24/444, 446, 447, 452; 264/167, 175, 209.3, 237, 280, 284, 310, 318, 334

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4,617,214 (BILLARANT) 14 October 1986. Column 1, lines 12-17 and Figure 3.	14 and 17-20
Y	US, A, 4,794,028 (FISCHER) 27 December 1988. Abstract.	1-13, 15 and 16
Y	US, A, 4,323,533 (BRAMHALL) 06 April 1982. Column 4, lines 32-40.	1-13, 15 and 16

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 19 AUGUST 1994	Date of mailing of the international search report 16 SEP 1994
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer ALEXANDER S. THOMAS Telephone No. (703) 308-2351

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/07556

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

428/100, 120; 24/444, 446, 447, 452; 264/167, 175, 209.3, 237, 280, 284, 310, 318, 334